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THE TIME REQUIRED FOR THE PRESENCE OF BULLS TO ALTER THE INTERVAL FROM PARTURITION TO RESUMPTION OF OVARIAN ACTIVITY AND REPRODUCTIVE PERFORMANCE IN FIRST-CALF SUCKLED BEEF COWS

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ABSTRACT

This experiment was designed to determine 1) if exposure of first-calf suckled beef cows to mature bulls in the first 30 days, after 30 days, or continuously post partum reduces the postpartum anestrous period and 2) if exposure to bulls alters the first service pregnancy rate. Postpartum first-calf suckled crossbred (Angus x Hereford; Hereford x Angus) cows were randomly assigned to be 1) exposed continuously to mature, epididectomized bulls (BE; n = 18); 2) exposed to bulls for the first 30 days post partum (BE/NE; n = 17); 3) exposed to bulls after the first 30 days post partum (NE/BE; n = 16); or not exposed to bulls (NE; n = 18). Blood samples were collected weekly to be assayed for progesterone to determine resumption of ovarian cyclic activity. All the cows were bred for 21 days by AI while under their respective treatment regimens and were then exposed to fertile bulls for an additional 35 days. The postpartum interval to resumption of ovarian cyclic activity did not differ (P>0.10) among the 3 (BE, BE/NE, and NE/BE) treatment groups, but it was 15.4 d shorter (P<0.05) than for cows in the NE group. The overall pregnancy rates did not differ (P>0.10) among the treatment groups. The AI pregnancy rates for the BE/NE and NE/BE treatment groups were higher (P<0.05) than for the NE group. The AI pregnancy rates for the BE and NE treatment groups did not differ (P>0.10). The results showed that all three treatments (BE, BE/NE and NE/BE) similarly decrease the postpartum interval and that exposure to bulls may improve the reproductive performance of first-calf suckled beef cows.

Key words: bovine, postpartum interval, biostimulation, pregnancy rates

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INTRODUCTION

The failure of females to rebreed after calving decreases reproductive efficiency in beef cattle production (1). One of the primary reasons that cows fail to rebreed, especially first-calf suckled cows, is long postpartum anestrous periods (2, 3). Many factors affect the length of the postpartum anestrous interval in beef cows (3). One of these is exposure to mature bulls which shortens the postpartum interval to resumption of ovarian cyclic activity in suckled, multiparous (4) and primiparous cows (5). The physiological interactions which induce this response are complex and remain unclear (5). To gain an understanding of the mechanism by which exposure to bulls shortens the postpartum anestrous interval it is first necessary to determine when and for how long cows need to be exposed to bulls after calving. Such knowledge would allow for specific recommendations regarding the use of bulls for altering postpartum reproductive performance in first-calf suckled beef cows.

The objectives of this experiment were to determine 1) if exposure of postpartum first-calf suckled beef cows to mature bulls during the first 30 days postpartum, after 30 days postpartum, or continuously reduces the postpartum interval to resumption of ovarian cyclic activity; 2) if exposure to bulls alters the proportions of cows that are bred by AI early in the breeding season; and 3) if exposure to bulls alters AI and total pregnancy rates.

MATERIALS AND METHODS

Sixty-nine first-calf, crossbred Hereford x Angus and Angus x Hereford beef cows maintained at the Bozeman Livestock Center, Montana State University, were assigned to 1 of 2 treatments within 72 hours of calving: 1) exposure to mature epididectomized bulls (BE; n = 35) or 2) isolation from bulls (NE; n = 34). At calving, the cows were assigned to treatment in groups of four in the following manner: The first cow to calve was randomly assigned to either the BE or NE treatment. The second and third cow to calve was assigned to the converse treatment, and the fourth cow to calve was assigned to the same treatment as the first cow, to obviate the effects of calving date. The body weight and condition score for each cow were obtained within 72 hours of calving and again within 72 hours of being bred by AI. Those cows that were not bred by AI were weighed on June 17, 1991. The average body weight and condition score of cows after calving were 454 ± 41 kg and 5.5 ± 0.1, respectively. The cows calved between February 1 and April 10, 1991, and the average calving date was February 27, 1991.

Cows assigned to the BE treatment were placed in a pasture with a bull to cow ratio of 1:19. Cows in the NE treatment group were placed into a pasture that was approximately 1 km away from the pasture that contained the cows in the BE treatment group so the NE group cows could not see, smell, hear or otherwise come into contact with a bull. On Day 30 post partum, the cows were randomly assigned either to remain in their initial treatment (BE, n = 18; NE, n = 18) or to be assigned to the converse treatments (BE/NE, n = 17; NE/BE, n = 16). Cows and their calves that were assigned to converse treatments were moved by trailer to the appropriate pasture.

All the cows were fed medium quality, mixed-grass alfalfa hay until pasture grasses became available, and were provided free access to mineralized salt and water.

Weekly blood samples were obtained by caudal venipuncture beginning on February 19. The samples were allowed to clot at 4°C then were centrifuged at 1850 x g at 4°C. Serum was harvested and stored at -20°C until it could be assayed for progesterone.

Cows in each treatment group were observed visually for behavioral estrus twice daily for 40 minutes, between 0600 and 0800 hours and again between 1700 and 1900 hours, beginning on March 15. Visual observation of behavioral estrus was used as corroborating evidence for progesterone data. Figure 1. shows a representative pattern of progesterone concentrations for a cow that showed a transient increase in progesterone before resumption of normal ovarian cyclic activity. Resumption of ovarian cyclic activity was defined as an increase in systemic progesterone concentrations above 0.5 ng/ml in 2 consecutive weekly samples. Resumption was defined as the day of the week before progesterone increased and remained high for 2 consecutive samples. For the above mentioned cow resumption would have occurred on Tuesday of Week 5.

Beginning on June 1, the cows in each treatment group were bred by AI for 21 days; the cows were bred 12 hours after the observation of estrus. The cows remained in their assigned treatments during the AI period. The breeding date for each cow bred by AI was recorded in order to determine if pregnancy was maintained. On June 22, all the cows were exposed to fertile bulls for 35 days. Pregnancy was diagnosed by palpation per rectum 46 days after the end of the breeding season.

Progesterone Assay

Progesterone concentrations in serum samples were quantified using solid-phase RIA kits.[b] The assay was modified and validated for use with cow serum instead of human serum in our laboratory by Custer (6). The sensitivity of this assay was 0.031 ng/ml, and the inter- and intra-assay CV's were 4.4 and 7.8%, respectively, for a serum pool that contained 1.45 ng/ml.

Statistical Analysis

Data for body weight change from 3 days after calving to the end of the experiment, the postpartum interval to resumption of ovarian cyclic activity and the number of estrous cycles before each cow was bred or had

[b]Diagnostic Products Corp., Los Angeles, CA.

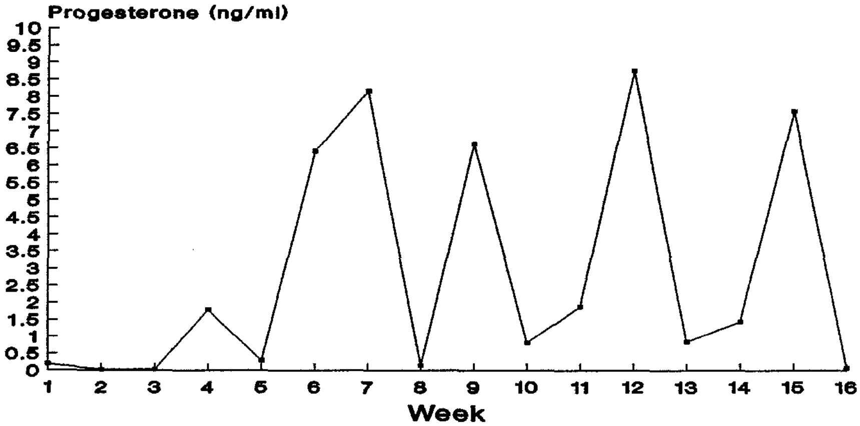

Figure 1. Serum progesterone concentrations during the postpartum period for cow no. 9064. This pattern depicts our definition for resumption of ovarian cycling activity in first-calf suckled beef cows (week = 5) and a "short" luteal phase before the first normal luteal phase (week = 4).

an opportunity to be bred by AI were analyzed separately by an analysis of variance for a completely randomized design using the General Linear Models procedures of SAS (7). Opportunity to be bred by AI was defined as the first day of the week that progesterone concentrations in the blood fell below 0.5 ng/ml during the AI breeding period. Data for the postpartum resumption of ovarian cyclic activity included all cows in each treatment. Those cows that had not met the definition for resumption of ovarian cycling activity were assigned a postpartum interval equal to the difference between 7 days after the end of the experiment and their calving dates. Orthogonal contrasts were used to compare the means for body weight change, postpartum interval to resumption of ovarian cyclic activity, and number of estrous cycles before being bred by AI (8). Specific contrasts for each of these variables were NE vs BE, BE/NE, NE/BE; BE vs BE/NE, NE/BE; and BE/NE vs NE/BE. The proportions of cows 1) that showed a rise in progesterone above 0.5 ng/ml before the first normal luteal phase; 2) that were bred by AI; and 3) that were pregnant at 46 days after the breeding season for BE, BE/NE, NE/BE, and NE cows were analyzed by Chi-square (8).

RESULTS

Body weight change, between 3 days after calving and the end of the experiment did not differ ($P>0.10$; Table 1) for cows in the BE/NE and NE treatments. Likewise, body weight change for cows in the BE treatment did not differ ($P>0.10$) from that of cows in the BE/NE or NE/BE treatments. However, cows in the BE treatment group lost more weight ($P<0.05$) than cows in the NE group (Table 1). Condition scores of cows at the end of the experiment did not differ ($P>0.10$) among the treatment groups and averaged 5.2 ± 0.1.

All cows in the BE, BE/NE and NE/BE treatment groups, and 90% of the cows in the NE group met the criterion (Figure 1) for resumption of ovarian cyclic activity by the end of the AI breeding season. The postpartum interval to resumption of ovarian cyclic activity was shorter ($P<0.05$) for BE, BE/NE and NE/BE group cows than for NE cows (Table 1). However, the postpartum interval to resumption of ovarian cyclic activity did not differ ($P>0.10$) among the BE, BE/NE and NE/BE groups of cows (Table 1).

Table 1. Least squares means for postpartum body weight change and interval to resumption of ovarian cyclic activity

Treatment[a]	n	Body weight change (kg)[b]	Postpartum interval (days)
BE	18	$-19.4^{c,d}$	46.5^{c}
BE/NE	17	$4.2^{c,e}$	50.9^{c}
NE/BE	16	-27.7^{d}	51.0^{c}
NE	18	18.2^{e}	64.7^{d}
SEM		28.9	17.6

[a] BE = continuous bull exposure, BE/NE = bull exposed for 30 d post-calving, NE/BE = bull exposed after 30 d post-calving and NE = not exposed to bulls.
[b] Final body weight on test minus body weight Day 3 post-calving.
[c,d,e] Means within columns with a different superscript are different ($P<0.05$).
df = 66 (SEM)

The proportions of cows in the BE/NE, NE/BE, and NE treatment groups that exhibited a rise in progesterone above 0.5 ng/ml before the first normal luteal phase (Figure 1) did not differ ($P>0.10$; Table 2). More ($P<0.05$) cows that were continuously exposed to bulls exhibited a rise in progesterone before the first normal luteal phase than cows in the NE/BE and NE treatment groups. However, the proportion of cows that showed a rise in progesterone before the first normal luteal phase did not differ ($P>0.10$) between BE and BE/NE groups of cows (Table 2).

The number of estrous cycles that had occurred by the time the cows were bred did not differ ($P>0.10$) among cows that were exposed at any time to bulls (Table 2). However, cows not exposed to bulls had approximately 0.5 fewer ($P<0.05$) estrous cycles before being bred than cows that were exposed to bulls at any time during the postpartum period (Table 2).

Table 2. Percentages of postpartum first-calf suckled beef cow that exhibited an increase in progesterone before the first normal luteal phase and number of estrous cycles by breeding

Treatment[a]	n	Percentage of cows	No. estrous cycles by breeding[b]
BE	18	72.2^{c}	2.6^{c}
BE/NE	17	$58.8^{c,d}$	2.5^{c}
NE/BE	16	31.3^{d}	2.5^{c}
NE	18	27.8^{d}	2.0^{d}

[a] BE = continuous bull exposure, BE/NE = bull exposed for 30 d post-calving, NE/BE = bull exposed after 30 d post-calving and NE = not exposed to bulls.
[b] SEM = 1.0; df = 65.
[c,d] Percentages and means within columns with a different superscript are different ($P<0.05$).

Table 3. Overall pregnancy rates, percentages bred by AI and AI pregnancy rates

Treatment	n	Overall Pregnancy Rates (%)	Number (%) bred AI	AI Pregnancy Rates (%)
BE	18	94^{a}	$14\ (78)^{a}$	$57^{a,b}$
BE/NE	17	100^{a}	$14\ (82)^{a}$	100^{c}
NE/BE	16	88^{a}	$13\ (81)^{a}$	$77^{b,c}$
NE	18	83^{a}	$14\ (78)^{a}$	29^{a}
Total	69	91	55 (81)	66

[a,b,c] Percentages within columns with a different superscript are different ($P<0.05$).

Overall pregnancy rates for the 56-d breeding season did not differ ($P>0.10$) among treatments (Table 3). Fifty-five of the 69 (80%) cows werebred by AI. Proportions of cows that were bred during the 21-d AI period did not differ (P>0.10) among treatments (Table 3).

Pregnancy rates for cows bred by AI were lower (P<0.05) for cows in the NE treatment than for cows in either the BE/NE or NE/BE treatments. AI pregnancy rates for cows in the BE treatment did not differ (P>0.10) from AI pregnancy rates of cows in the NE/BE or NE treatments (Table 3). However, the AI pregnancy rate was higher (P<0.05) for cows in the BE/NE treatment group than cows in the BE group (Table 3). There was no difference (P>0.10) in the AI pregnancy rates between cows in the BE/NE and NE/BE treatment groups (Table 3).

DISCUSSION

The postpartum interval to first estrus is a major factor determining whether or not cows become pregnant and, in first-calf cows, the postpartum interval to estrus is 15 to 25 days longer than in multiparous cows (2, 3, 9, 10). Continuous exposure of postpartum first-calf suckled beef cows to mature bulls reduced the postpartum interval to resumption of ovarian cycling activity by an average of 18 days. This finding confirms results obtained in our laboratory in past experiments (5) which indicate that exposing first-calf cows to mature bulls decreases the postpartum interval to resumption of ovarian cycling activity. In the present study, we evaluated whether or not the postpartum interval to resumption of ovarian cyclic activity could be altered by 1) exposing cows to bulls for the first 30 days postpartum or 2) exposing cows to bulls after the first 30 days postpartum. The results showed that exposure to bulls either for the first 30 days or after 30 days post partum decreased the postpartum interval to the same extent as continuous exposure. Although cows in the BE and NE/BE treatment groups lost body weight, the postpartum interval to resumption of ovarian cyclic activity did not differ from that of the cows in the BE/NE group. In addition, the postpartum interval to resumption of ovarian cyclic activity of cows in the BE and NE/BE treatment groups was shorter than that of cows in the NE group, which gained weight. A practical implication of these results is that cows do not need to be exposed to bulls immediately after calving, or they may be exposed to bulls for as little as 30 days after calving, to achieve the same level of reproductive performance. Furthermore, a set of bulls may be used on more than one group of cows over the course of the postpartum anestrous period.

The physiological explanation and the mechanism involved in the bull effect remains unclear. Nevertheless, this narrows the time frame in which investigation of the effect of bulls need be performed.

The overall pregnancy rates in this experiment did not differ among treatment groups which is similar to the results reported by Berardinelli et al. (12) for cows exposed or not exposed to bulls but bred as a single group. However, the proportion of cows in the BE/NE and NE/BE treatments that became pregnant after AI was greater than that for the NE group of cows. Roberson et al. (11) reported that pregnancy rates following AI were higher in heifers exposed to mature bulls prepuberally than in heifers not exposed to bulls; however, the total pregnancy rate did not differ (11). In addition, Zalesky et al. (4) found that fertility at first breeding increased when cows had been exposed to sterile bulls.

Improvement in AI pregnancy rates for cows exposed to bulls appeared to have been due to the number of estrous cycles that occurred before the cows were bred. Although the number of estrous cycles completed by cows exposed to bulls (BE, BE/NE and NE/BE) was higher than the number of estrous cycles completed by NE cows, only 2 of the 11 cows that exhibited only a single estrous cycle failed to maintain pregnancy when bred by AI. However, caution should be exercised in the interpretation of these results due to small sample size.

In summary, exposing first-calf cows to bulls reduced the postpartum interval to the resumption of ovarian cyclic activity. The bull effect can occur either within the first 30 days postpartum or after the first 30 days postpartum; the continued presence of bulls is not necessary for ovarian cyclic activity to continue. More estrous cycles had occurred before the cows were bred by AI in cows exposed to bulls than in those not exposed to bulls. Cows exposed to bulls maintained pregnancy more readily when bred by AI than those which had not been exposed to bulls. Producers can improve the reproductive performance of first-calf suckled beef cows by exposing them to mature, sterile bulls for either the first 30 days post partum or after the first 30 days post partum.

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